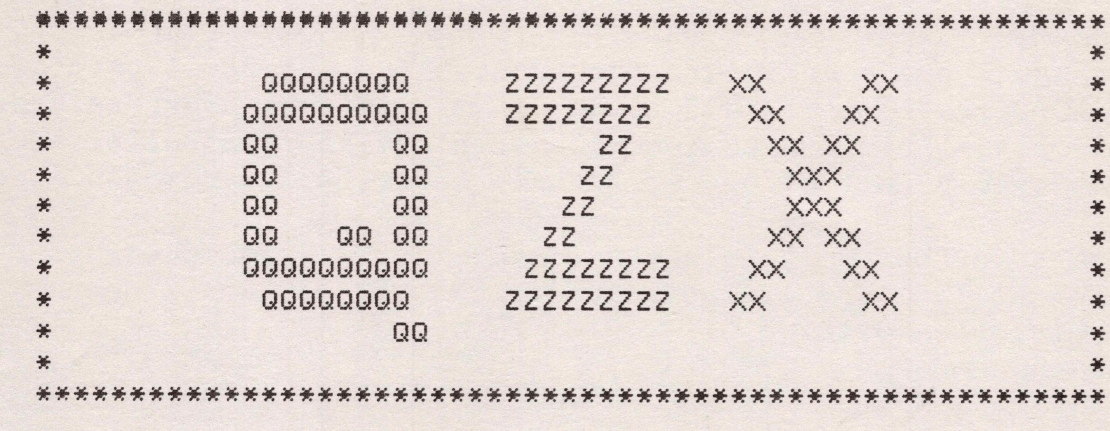

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* Sinclair Station Control System, LU8MAD
* Unclassified Ads

SINCLAIR STATION CONTROL SYSTEM

With this issue we start a series of articles on amateur station control with a T/S 1000. Written by LU8MAD, this series is the most complete computer station control unit published for any computer. And it all uses an inexpensive Sinclair computer. In this issue is an automatic antenna direction controller which also serves as a basis for the articles to come. These articles include an RS 232 interface and a YAESU FT-757 GX transceiver controller. Read on for many illuminating solutions to computer control problems. We all owe LU8MAD a great debt for making this work available.

TURN OR NOT TURN? THAT IS THE QUESTION....

Fig. 1 is a block diagram of the fully automatic system for the Ham shack, as I have done!

Some time ago I had send to QZX for publication the first part of this series: CLK/1000 based in MSM5832 clock. That interface provides a great facility: timed positioning in conjunction with rotator controller board.

Now in the second part of three, I shall describe the rotator - control interface.

The system described here is a single-rotator, fully automatic controller easily adapted at two separate rotator device when you are tracking those low-orbits satellites with both azimuth and elevation rotators.

TO BE OR NOT TO BE? or an INTELLIGENT TS-1000

The small Sinclair TS1000 is very intelligent and with the interface and software described here is capable of making decisions.

In our case, the decisions are relatively simple: is the rotator moving? Where is the rotator pointing? Where should it be pointed? How should it be moved, if at all? Is the rotator stopped?

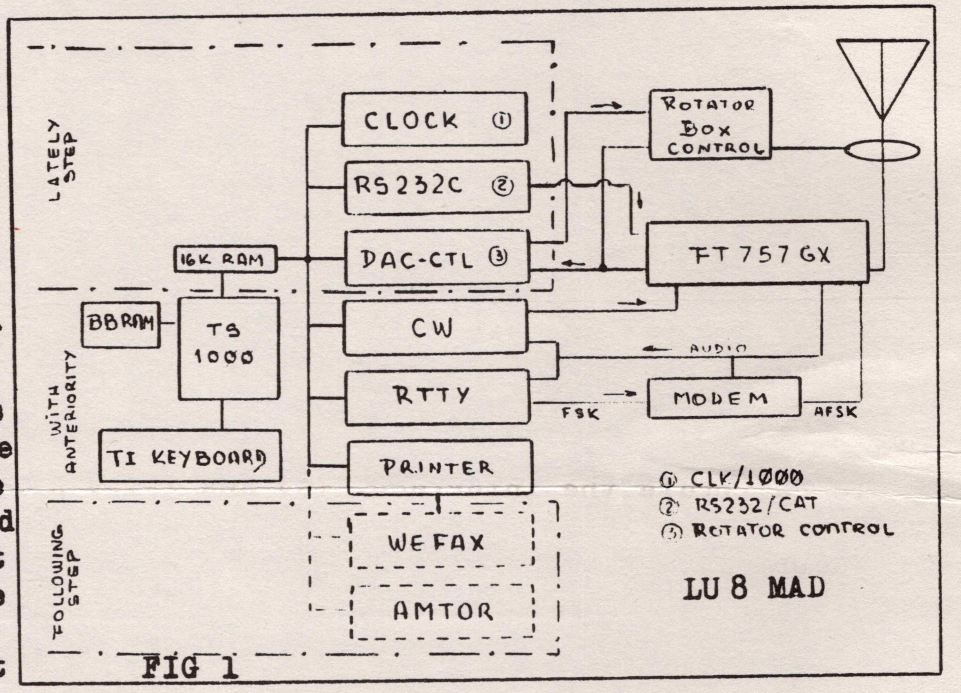


FIG 1

The TS1000/interface/Soft conjunction, work in this manner:

1- Rotator position is detected by examining the voltage developed across the position-sense potentiometer. 2- The value of this voltage is determined by comparing it to the voltage from a digital-to-analog converter that it set by the software. 3- The software can "see" where the rotator is pointing.

The computer-to-beam rotator interface consists of three I/O ports, a D/A converter, a voltage comparator and a set of control relays (or Triac's).

I/O port A of the 8255A programmable peripheral interface is used to pass a digital value between Ø and 255 to the MC1408L8 D/A converter which generates a corresponding current and OP AMP 741 converts into a voltage.

Voltage comparator LM 311 determines whether the voltage is larger than the analog voltage coming from the rotator. This design assumes that the rotator include a linear feedback potentiometer.

Comparator output is passed back to the computer via I/O port C, and the TS-1000 decides whether rotation is required and if so, in which direction.

The computer initiates rotation via port B of the 8255A using three of the eight output pins to operate switching relays. The outputs of pot B are latched and while the rotator is in motion, the rotator analog voltage is monitored and compared to the desired beam heading value. When the values

are equal, the port B outputs are turned off, stopping the rotator.

The subroutine DAC determines "greater than" rather than "equals", and this to give some difference between the desired rotator position, and the measured rotator position. Search just value will cause the computer to send the rotator continuously back and forth across the desired position, never fully stopping, and possibly damaging the motor.

A value lightly more greater than desired rotator position will allow an error which may not be a problem on a fairly wide-beam width antenna.

The weak point of many rotators is the position-sense potentiometer (see Fig. 6). This was designed to operate with a meter on a control box.Accuracy and reliability of these potentiometers are not all one might desire.

A useful modification would be to replace the existing position-sense device with one that uses a sealed, multiturn potentiometer. (see alternative below)

CONNECTING THE ROTATOR

The relay contacts are wired in parallel with the rotator control box switches where they are used to control the 120 and 24 AC transformer and motor leads. My rotator control box has plenty of room inside.

See figure 6 to wire relay contacs in parallel with switches. Figures 4 & 5 are alternatives of the fig. 3.

Relay 1 wired between C and A; Relay 2 wired between C and B; and Relay 3 between D and E. To drive relays, you will extract +V from (F) via a silicon diode and electrolytic capacitor, relay 3 from another power supply.

CALIBRATION

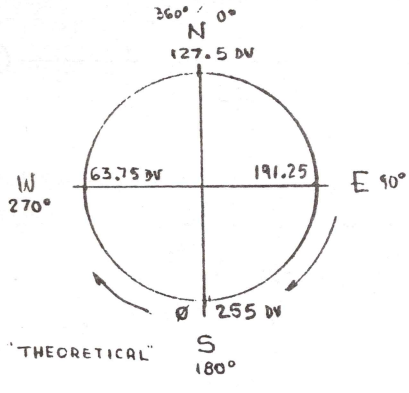
To calibrate the interface, +5V and $\pm$ 12V are applied, and the digital value 255 supplied to port A. (Putting 255 with program #T1)

Adjust R1 for the desired maximun D/A converter voltage (2.55V results in a 0.01V resolution)

Manually rotate the antenna to the position that produces the largest analog indicator voltage. This position is clockwise South in my rotator and produces 13V at pin 5 of the connector (Fig 6).

Adjust R2 to produce 2.55V, the same voltage value of the D/A converter.

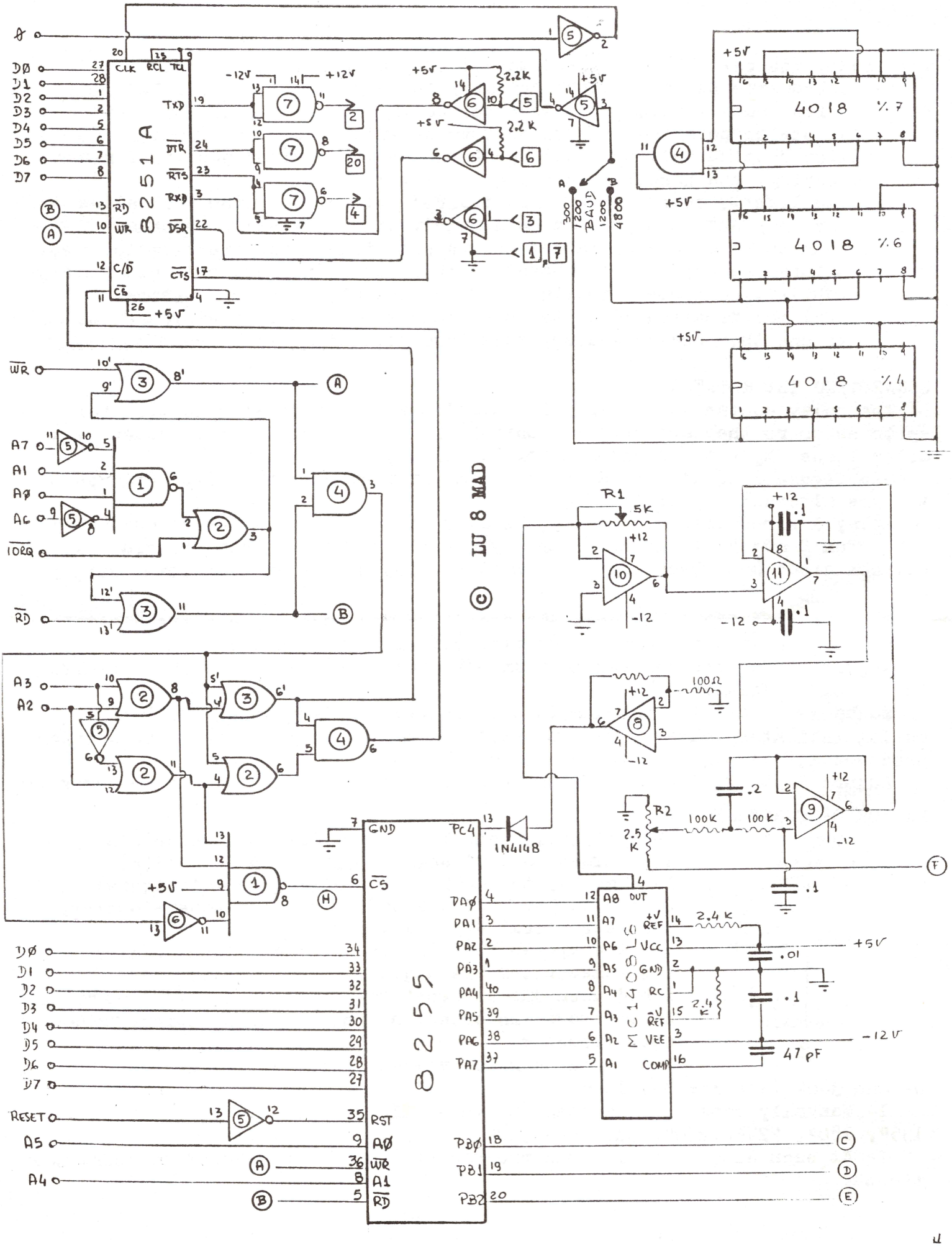
FACTOR OF CONVERSION



Theoretically each 1.41176 DV (digital value) is just equivalent to 1.00 degrees (360°/255 = 1.41176)
In example, to NORTH position (0°) that is equivalent to middle point of the position-sense potentiometer, the theoretical digital value is 127.5 DV.
But the system read (in my work condition) 123 DV.
The reason: deficient quality of potentiometer.
I had used one alternative to avoid to come down rotator of the tower in order to replace the position- sense potentiometer.
I had read digital values (Ø to 255 DV) each 45° between 0° and 360° (see Fig 8). Them:

1- Manually rotate the antenna to the following positions: 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315° and 360°

2- At each above position run program #T1 and I had read DV of those positions


8251A
CLK
RCL
TCL
TXD
DTR
RTS
RXD
DSR
CTS
C/D
CS
WR
RD
D0
D1
D2
D3
D4
D5
D6
D7
+5V
-12V
+12V
2.2K
300
1200
BAUD
1200
4800
4018 ÷7
4018 ÷6
4018 ÷4
IORQ
A7
A1
A0
A6
A3
A2
© IU 8 MAD
R1
5K
100Ω
.2
100K
R2
2.5 K
.1
.01
47 pF
2.4 K
IN4148
8255
GND
PC4
RESET
A5
A4
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PB0
PB1
PB2
RST
A0
A1
WR
RD
CS
A8
OUT
VCC
GND
RC
VEE
COM
+V REF
-V REF

IF YOU NOT WISH TO MAKE SERIAL INTERFACE PART THEN USE THIS ADDRESS DECODER ONLY FOR ROTATOR CONTROL

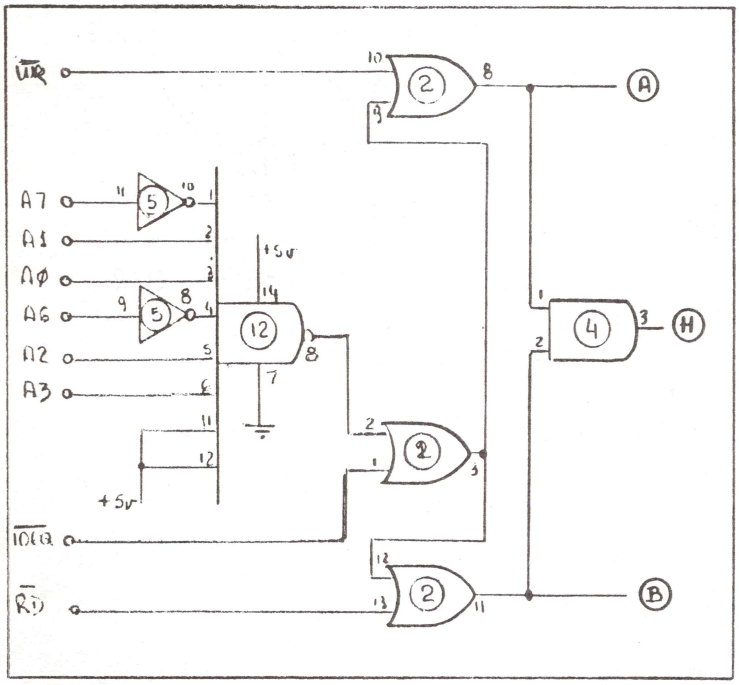


Fig. 2

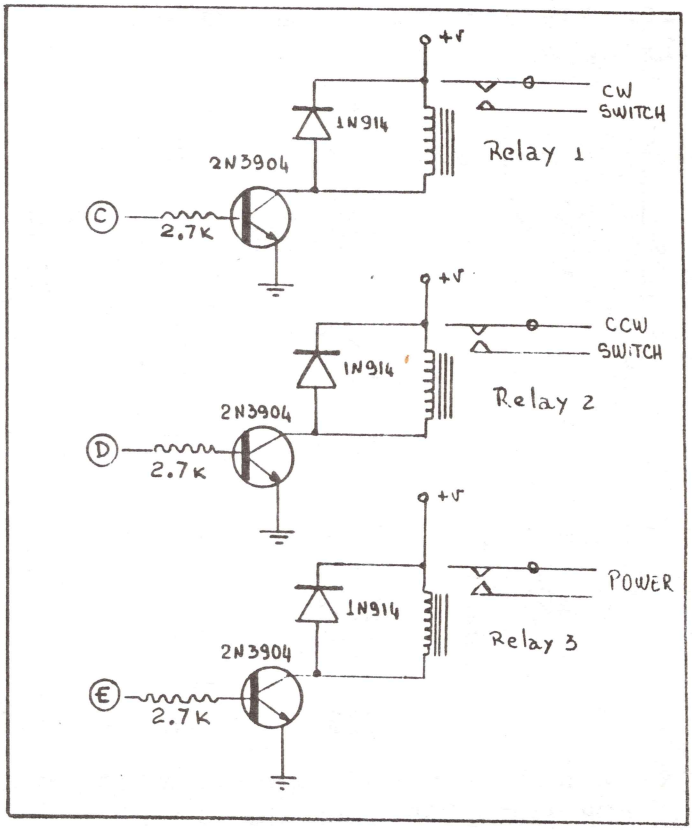


Fig. 3

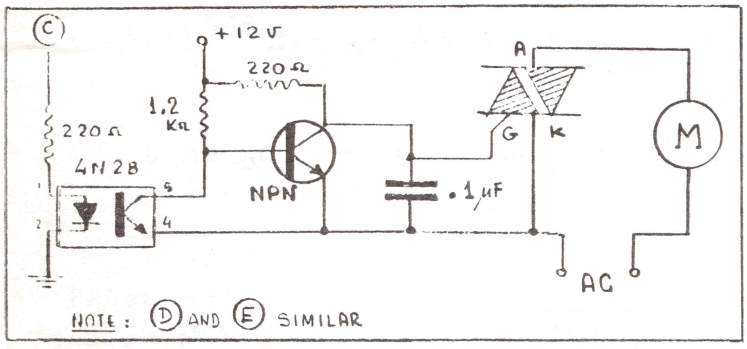


Fig. 4

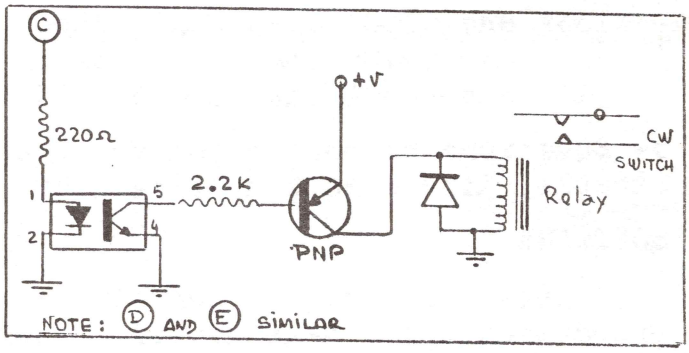


Fig. 5

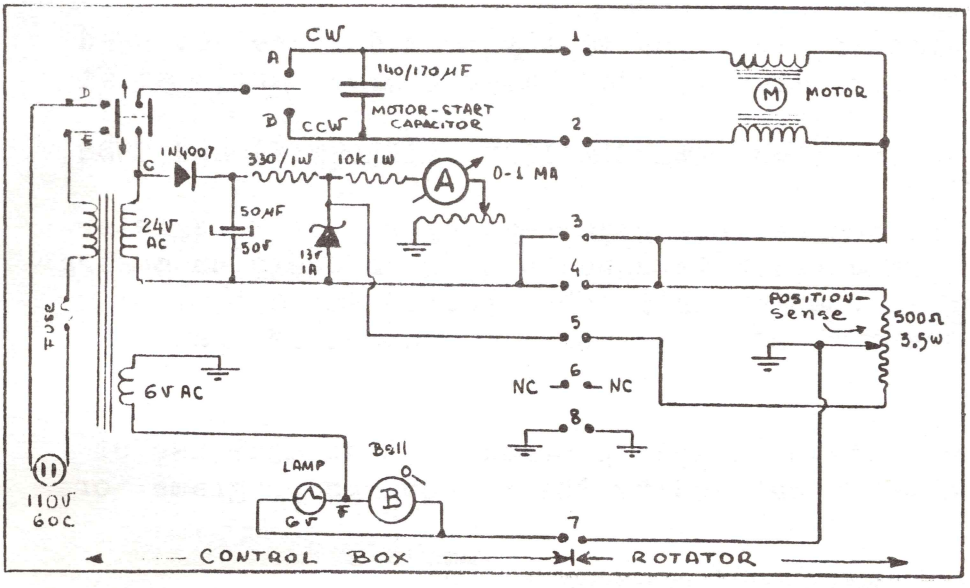
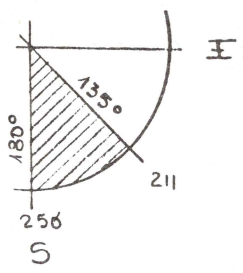


Fig. 6

IC's	#		
1	74LS20	7	MC1488
2	74LS32	8	LM 741
3	74LS32	9	LM 741
4	74LS08	10	LM 741
5	74LS04	11	LM 311
6	MC1489	12	74LS30

3- Then, I had distributed that value between each degree of the 45° sector, in order to obtain one value for the conversion equation.
Example:

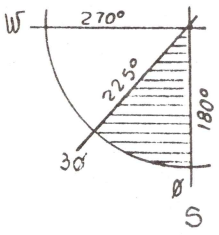


135° =211 DV
180° =250 DV

135° ___ 211 DV
136° ___ $211 + \left(\frac{250 - 211}{180 - 135}\right) \times 1 =$

$= 211 + ((39/45) \times 1) = 211 + 0.8666 = 211.866 \cong 212$

137° ___ 211 + (Ø.8666 x 2) ≅ 212,7332 ≅ 213
138° ___ 211 + (Ø.8666 x 3) = 213.5998 ≅ 214
≀ ≀ ...and so ...
180° ___ 211 + (Ø.8666 x45) = 249.997 ≅ 250



180° ___ Ø DV
181° ___ Ø + (30/45 x 1) = Ø.6666
182° ___ Ø.6666 x 2 = 1.333 ≅ 1
183° ___ Ø.6666 x 3 = 1.9998 ≅ 2
≀ ≀ ...and so ...
225° ___ Ø.6666 x45 =29.999 ≅ 3Ø

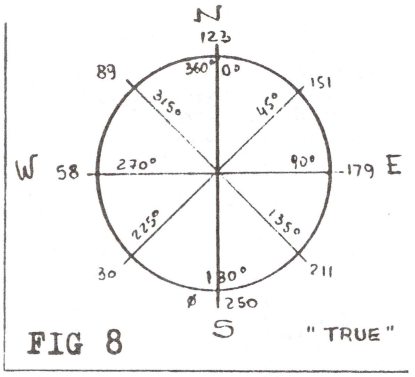


FIG 8

4- I had obtained the following constant values for my rotator:

>0° and <90° them C= 0.6222	>90° and <135° them C = 0.7111
>135° and <180° them C = 0.8666(*)	>180° and <225° them c = 0.6666(*)
>225° and <270° them C = 0.6222	>270° and <315° them C = 0.6888
>315° and <360° them C = 0.7555	(*)see above example

5- Equations of conversion are used into main program (see in program of example, Line * 3000 to Line 3710)

SOFTWARE

Since this program contains a mid amount of machine language, the usual precaution hold. Make use of Loader ML program. Place holder in 1 REM with 180 periods. Enter machine code from List #1 . Loader program should be deleted after code is entered.

As you can see in the assembler List, the lastly 30 codes are not used in this application. Those ML codes will be used later (third part) as it is part of RS232C/CAT program.

All I/O ports are fully compatibles with CLK/1000; NRAP(RTTY) and CWSS (CW) programs of CLIFF (NU4V).

The program expects to find the desired beam heading in the L register as a value between 0 and 255. This value is used in program decision making with control remaining in the ML routine until the desired and actual headings are the same. When the two values are equal, control is passed back to the BASIC program.

APPLICATION OF THIS SUBROUTINE

I have enclosed in this article un sample program that to make use of subroutine for rotator control. You can modify the followings programs or writing another:

1) "DX-Bearing-Distance", W1EFK, QZX Vol 1, = 5 (1983)
2) "Direction finding", N3CHT, QZX Vol 1, = 8 & 9 (1983)
3) "Distance", SYNTAX Vol 4, = 9 (1983)

In those programs you can adapt Lines 2722 & 2740, and 3000 to 4025 of sample program of below.

"DX-COUNTRY INDEX WITH ROTATOR CONTROL"

```
  1 REM (180 periods - see assembler list and instructions)
  2 GOTO 5000
  8 FAST
 10 CLS
 15 PRINT
 30 PRINT AT 8,5; "1 OPEN FILE",,
 40 PRINT TAB 5; "2 SEARCH",,
 96 PRINT TAB 5; "3 ALTER",,
 98 PRINT TAB 5; "4 VIEW ALL",,
100 PRINT AT 21,7;"ENTER CHOICE"
105 IMPUT C
110 IF C<1 OR C>4 THEN GOTO 100
150 GOSUB 2000
160 IF C = 1 OR C = 3 THEN GOTO 1000
185 IF C = 2 THEN GOTO 2700
190 IF C = 3 THEN GOTO 2800
191 IF C = 4 THEN GOTO 2900
200 IF C = 1 THEN IMPUT F$(L)
205 IF F$(L,1 TO 3) = "END" THEN
    GOTO 2600
210 PRINT F$(L)
215 LET L = L + 1
220 IF C = 1 AND L>384 OR C = 3 AND
    L > 384 THEN GOTO 2600
235 GOTO 200
250 STOP
1000 LET L = 1
1010 GOTO 170
2000 CLS
2010 RETURN
2100 LET L = 1
2105 RETURN
2600 PRIN AT 21,0:"KEY ENTER TO CONTI-
    NUE"
2605 IMPUT Z$
2610 GOTO 10
2700 GOSUB 2000
2705 PRINT " PX - SP-   COUNTRY   - LP "
2709 PRINT "_____"
2710 IMPUT Z$
2711 LET D = LEN Z$
2715 LET L = 1
2720 IF F$(L, TO D) = Z$ THEN PRINT "FI
    LE SLOT ";L;TAB Ø;F$(L)
2722 IF F$(L, TO D) = Z$ THEN LET ANG
    = VAL F$(L,5 TO 8)
2725 LET L = L + 1
2730 IF L> 384 THEN GOTO 2740
2735 GOTO 2720
2740 GOTO 3000
2742 GOTO 2600
2800 GOSUB 2000
2805 IF F$(L,1 TO 3)= "END" THEN GOTO
    2820
2810 LET L = L + 1
2815 GOTO 2805
2820 PRINT "FILE ENDS AT SLOT: ";L
2825 PRINT "ENTER ""END"" TO EXIT"
2830 IMPUT F$(L)
2835 IF F$(L,1 TO 3) ="END" THEN GOTO
    2600
2840 PRINT F$(L)
2845 LET L = L + 1
2850 IF C = 3 AND L>384 THEN GOTO 10
2865 GOTO 2830
2900 GOSUB 2000
2905 FOR L = 1 TO 384
2906 PRINT L
2910 PRINT F$(L)
2911 IF PEEK 16442 > 4 THEN GOTO 2915
2912 PAUSE 4E4
2914 CLS
2915 NEXT L
2920 GOTO 2600
3000 LET G = ANG
3002 IF G>= 315 AND G<=360 THEN GOTO
    3100
3004 IF G>= 270 THEN GOTO 3200
3006 IF G>= 225 THEN GOTO 3300
3008 IF G>= 180 THEN GOTO 3400
3010 IF G>=135 THEN GOTO 3500
3012 IF G>= 90 THEN GOTO 3600
3014 IF G >= Ø  THEN GOTO 3700
3016 IF G > 360 OR G < Ø THEN RETURN
```

```
3100 LET Z = G - 315
3110 LET R = (0.7555 * Z) + 89
3120 GOTO 4000
3200 LET Z = G - 270
3210 LET R = (0.6888 * Z) + 58
3220 GOTO 4000
3300 LET Z = G - 225
3310 LET R = (0.6222 * Z) + 30
3320 GOTO 4000
3400 LET Z = G - 180
3410 LET R = (0.6666 * Z)
3420 GOTO 4000
3500 LET Z = G - 135
3510 LET R = (0.8666 * Z) +211
3520 GOTO 4000
```

-- o --

PX = prefix; SP = short path;
LP = long path

```
3600 LET Z = G - 90
3610 LET R = (0.7111 * Z) + 179
3620 GOTO 4000
3700 LET Z = G
3710 LET R = (0.6222 * Z) + 123
4000 IF R = 0 THEN LET R = 1
4010 POKE 16515, INT (R + 0.5)
4020 RAND USR 16514
4030 GOTO 8
4035 STOP
5020 RAND USR 16652
5030 STOP
```

-- o --

First time you load the program dimension the files by entering: DIM F$(384,26) then enter GOTO 8

-- o --

TEST-PROGRAM (and for calibration)

PROGRAM T1

Load in 1 REM (28 periods) the following data: 62 136 211 63 6 64 14 157 10 211 15 201 219 31 6 0 79 201 62 1 211 47 201 0 0 0 0 0

```
10 POKE 16524, 47
20 POKE 16541, 4
30 RAND USR 16514
40 FOR A = Ø TO 255
50 POKE 16524,15
60 POKE 16541, A
65 RAND USR 16518
70 PRINT AT 10,10;" "; AT 10,10; A
80 LET G = USR 16526
90 PRINT AT 10,20;"  "; AT 10,20;G
95 IF G = 16 THEN GOTO 140
100 NEXT A
140 POKE 16541,0
150 POKE 16524,47
160 RAND USR 16514
```

ML PROGRAM OPERATION

The followings descriptions are with reference to LIST 1 (ROTATOR CONTROL - ASSEMBLER)

ADDR 16514	Load desired beam
16515	heading
16516	To switch on C.Box
to 16526	& see actual position
16529	ADDR of value seen
16530	Making decision
to 16547	
16548	Turn clockwise
to 16578	
16579	Turn counter -CW
to 16606	
16607	Buffer
to 16620	
16621	Delay
to 16625	
16626	D/A converter
to 16648	subroutine
16652	To switch off control box
to 16661	and return to BASIC
16665	ML for RS232C/ CAT System
to 16693	(see third part)

- - My thanks to GABY NOBILTA, for his patience and helpful counsel in troubleshooting.

Guillermo García, LU8MAD, Cabildo 584, (5521) MENDOZA, ARGENTINA.

```
16514   46  LD L, N
16515    0
16516   62  LD A, N
16517  136
16518  211  OUT(63), N
16519   63
16520   62  LD A, N
16521    4
16522  211  OUT(47), N
16523   47
16524  205  CALL DAC
16525  242  (16626)
16526   64
16527   24  JR DIS
16528    1
16529    0
16530   58  LD A,(NN)
16531  145  (16529)
16532   64
16533  205  CALL DELAY
16534  237  (16621)
16535   64
16536  254  CP N
16537    0
16538  202  JP Z, NN
16539  140  (16524)
16540   64
16541  189  CP L
16542  202  JP Z, NN
16543   12  (16652)
16544   65  GO BASIC
16545  242  JP P,NN
16546  195  (16579)
16547   64
16548   62  LD A, N
16549    5
16550  211  OUT(47),A
16551   47
16552  205  CALL DAC
16553  242  (16626)
16554   64
16555  205  CALL DELAY
16556  237  (16621)
16557   64
16558   58  LD A,(NN)
16559  145  (16529)
16560   64
16561  149  SUB L
16562  250  JP M, NN
16563  168  (16552)
16564   64
16565   58  LD A, (NN)
16566  145  (16529)
16567   64
16568  254  CP N
16569    0
16570  202  JP Z, NN
16571  168  (16552)
16572   64
16573  195  JP NN
16574   12
16575   65
16576    0  NOP
16577    0  NOP
16578    0  NOP
16579   62  LD A, N
16580    6
16581  211  OUT(47),A
16582   47
16583  205  CALL DAC
16584  242
16585   64
16586  205  CALL DELAY
16587  237
16588   64
16589   58  LD A, (NN)
16590  145  (16529)
16591   64
16592  142  SUB L
16593  242  JP P, NN
16594  199  (16583)
16595   64
16596   58  LD A, (NN)
16597  145  (16529)
16598   64
16599  254  CP N
16600    0
16601  202  JP Z, NN
16602  199  (16583)
16603   64
16604  195  JP NN
16605   12  (16652)
16606   65
16607   62  LD A, N
16608    4
16609  211  OUT(47), A
16610   47
16611    6  LD B, N
16612    2
16613  205  CALL DELAY
16614  237  (16621)
16615   64
16616   16  DJNZ, N
16617  251
16618  195  JP NN
16619  140  (16524)
16620   64
16621    6  LD B, N
16622  100
16623   16  DJNZ, N
16624  254
16625  201  RET
16626   14  LD C, N
16627    0
16628  121  LD A, C
16629  211  OUT(15), A
16630   15
16631    6  LD B, N
16632  100
16633   16  DJNZ, DIS
16634  254
16635  219  IN A, 31
16636   31
16637  254  CP N
16638    0
16639   32  JPNZ, DIS
16640    3
16641   12  INC C
16642   24  JR DIS
16643  240
16644  121  LD A, C
16645   50  LD (NN), A
16646  145  (16529)
16647   64
16648  201  RET
16649    0  NOP
16650    0  NOP
16651    0  NOP
16652   62  LD A, N
16653    0
16654  211  OUT(47),A
16655   47
16656   62  LD A, N
16657    0
```

```
16658   50  LD (NN), A
16659  145  (16529)
16660   64
16661  201  RET
16662    0  NOP
16663    0  NOP
16664    0  NOP
16665  175  XOR A
16666  211  OUT(59),A
16667   59  3B
16668    0
16669  211  OUT(59),A
16670   59  3B
16671    0
16672  211  OUT(59),A
16673   59  3B
16674   62  LD A, N
16675   64  ;RESET
16676  211  OUT(59),A
16677   59  3B
16678   62  LD A, N
16679  206  ;MODE
16680  211  OUT(59),A
16681   59  3B
16682   62  LD A, N
16683   17  ;COMMAND
16684  211  OUT(59),A
16685   59  3B
16686  201  RET
16687    0
16688   58  LD A, (NN)
16689   47
16690   65
16691  211  OUT(51),A
16692   51  33
16693  201  RET
```

UNCLASSIFIED ADS

WANTED: UNCLASSIFIED ADS for publication in QZX. Cost is 1 cent for each keystroke (characters, blanks, etc.). Payment must be included with order. This is an excellent way to sell your program or unwanted equipment, ask for help, or find a specific program. Send your ad with payment to QZX, 2025 O'Donnell, Las Cruces, NM 88001.

WANTED: Copy of Z-XLR8 program (high speed) with instructions. In return I will send a cassette with "DXCC-ROTATOR CONTROL", "CAT", "SCANNER" AND "TERMINAL" (all programs for the interface given in my articles in QZX). Send to Guillermo Garcia, LU8MAD, Cabildo 584, (5521) Mendoza, ARGENTINA.

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FOR SALE: ZX Spectrum computer 48 K color & sonnd with 60 Hz 120 V supply. Computer output on ch. 33 UHF TV band. Complete package w/ prints and manuals, some software. $75.00 mint cond. James Zilvilis WA1JBS, 46 Hart St., Watertown, Conn 06795.

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